

## CHAPTER 4

## INTAKES

4-1. General. The intake is an important feature of surface-water collection works. For fairly deep streams, whose flow always exceeds water demands, the raw water collection facilities generally consist of an intake structure located in or near the stream, an intake conduit, and a raw water pump station. Often the intake and pump station are combined in a single structure. On smaller, shallow streams, a channel dam may be required to provide adequate intake submergence and ice protection. Inlet cribs of heavy-timber construction, surrounding multiple-inlet conduits, are frequently employed in large natural lakes. For impounding reservoirs, multiple-inlet towers, which permit varying the depth of withdrawal, are commonly used. Hydraulically or mechanically-cleaned coarse screens are usually provided to protect pumping equipment from debris. If the stream is used for navigation, the intake design should include consideration of navigation use and of impact from boats or barges out of control.

4-2. Capacity and reliability. The intake system must have sufficient capacity to meet the maximum anticipated demand for water under all conditions during the period of its useful life. Also, it should be capable of supplying water of the best quality economically available from the source. Reliability is of major importance in intake design because functional failure of the intake means failure of the water system. Intakes are subject to numerous hazards such as navigation or flood damage, clogging with fish, sand, gravel, silt, ice, or debris, extreme low water not contemplated during design, and structural failure of major components. Many streams carry heavy suspended silt loads. In addition to suspended silt, there is also a movement of heavier material along the bed of the stream. The intake must be designed so that openings and conduits will not be clogged by bed-load deposits. An additional problem, caused by suspended silt and sand, is serious abrasion of pumps and other mechanical equipment. Excessive silt and sand may also cause severe problems at treatment plants. Liberal margins of safety must be provided against flood hazards and also against low-water conditions. A depression dredged in the stream bed to provide submergence is not a solution to the low-water problem because it will be filled by bed-load movement. A self-scouring channel dam may be the only means of assuring adequate water depth. As an alternative to unusually difficult intake construction, gravel-packed wells and horizontal collector infiltration systems located in the alluvium near the river are often worthy of investigation. Water obtained from such systems will usually be a mixture of ground water and induced flow from the stream.

4-3. Ice problems. In northern lakes, frazil ice (a slushy accumulation of ice crystals in moving water) and anchor ice (ice formed beneath the water surface and attached to submerged objects) are

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significant hazards, while on large rivers, floating ice has caused damage. Intake design must include ample allowances for avoiding or coping with these hazards. The intake location and inlet size are important aspects of design. Excessive inlet water velocities have been responsible for major clogging problems caused by both sand and ice. Inlet velocities in the range of 0.25 to 0.5 fps are desirable for avoiding ice clogging of intakes. Where ice is a problem, river intakes must have the structural stability to resist the thrust of ice jams, and the openings must be deep enough to avoid slush ice which has been reported as deep as 6 to 8 feet. Frazil and anchor ice can also cause difficulties, but on rivers, floating ice is usually the greater hazard. Steam heating has been employed to cope with ice problems at some northern lake intakes. Nonferrous materials are preferred for cold-climate inlet construction because their lower heat conductivity discourages ice formation.

4-4. Intake location. Meandering streams in deep alluviums pose especially difficult intake problems. Here, dikes, jetties, and channel protection may be required to prevent the river channel from moving away from the intake or cutting behind it. On such streams, careful consideration must be given to intake location. Generally, the intake site should be on the outside bank of a well established bend where the flow is usually swiftest and deepest. If the outside bend site includes a rock bank, a reliable intake probably can be placed there. Inside bends are to be avoided because of shallow water and sand bars. Sufficient depth at extreme low stage must also be a consideration. In addition to structural and hydraulic considerations, water quality is of major importance in connection with intake design and location, and the water quality aspects of a proposed location should be carefully examined. The location study should include a sanitary survey whose objective is evaluation of the effects of existing and potential sources of pollution on water quality at the intake site. The survey should include a summary of historical water quality data at the site plus an assessment of the probable impact of all wastewater discharges likely to influence present or future quality.